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TIMING BEHAVIOR AND STIMULUS GENERALIZATION

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During stimulus generalization testing after discrimination training gradual rate of decrements extending from S^D to S^Δ are commonly observed. The behavior over this range is assumed, therefore, to have decreasing "strength" across the stimuli. An alternate explanation is that the behavior that occurs during stimulus generalization testing (and other procedures, e.g., the CER procedure) occurs at full strength, but only occasionally, its frequency being determined by the proximity of the test stimulus to the training stimulus. Using a single lever technique it is difficult to obtain appropriate measures to examine this possibility. The question has been examined in the present experiment by using a two-response procedure. If reinforcement is contingent upon a proper time delay from response A to response B, one can then examine these time delays as well as the overall rate at which they occur during stimulus generalization.

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Subjects:

The subjects were two adult male albino rats.

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Procedure:

The rats were placed in test cages mounted vertically. A sliding panel containing two response keys and a feeder moved from one rat to the other to alternate training sessions. The rats remained in these cages at all times and obtained all nourishment from food reinforcement (water was ad lib.). Daily sessions for each rat were 11 hours in duration. The experiment was programmed with conventional relay circuitry and the data was recorded on punched paper tape and analyzed on an RPC-4000 computer.

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The rats were trained to peck key A when it was illuminated. The peck turned off the key A light and illuminated key B. A peck on the illuminated key B turned off the key B light and turned on the key A light, etc. The key B response was reinforced with a food pellet. A minimum time delay of two seconds between the key A response and the key B response was then added. The purpose of this was to permit the independent variable to affect this dependent variable -- the A to B time -- as either an increase or a decrease. Subsequently a random ratio schedule reinforcement of about 8 was gradually imposed on the A to B responses that exceeded two seconds. Finally, a discrimination was established in which responses were reinforced only when the illumination on the keys was bright (S^D) and extinction was in effect during dim illumination of the keys. The stimuli changed every 60" in a mixed sequence. Generalization testing over a range of eight stimuli was carried out for four sessions after the discrimination was well established. The generalization tests lasted one hour and were carried out in extinction. The results of this procedure suggested that while the frequency of A-B sequences declined appropriately over the stimulus range, the temporal distribution of responses showed little change. The A to B performance in the region of S^Δ, however, appeared somewhat slowed. Unfortunately, not enough data could be collected with this procedure since the rats extinguished almost completely by the fourth generalization test session. The procedures were modified to eliminate this effect. The animals were retrained on the discrimination procedure and generalization tests were rerun.

Modified Procedure:

1. The stimulus range was expanded to provide greater discriminability between stimuli.

2. The illumination on key B was eliminated. That is, key A was illuminated with either S^D or S^Δ; a response on key A darkened the chamber; a response on key B reilluminated key A.

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3. The stimulus duration was set at 30 seconds to permit a greater sampling of performance across the stimuli during generalization. The stimuli changed whether the last response was an A or a B, that is, whether the rat was working or not.

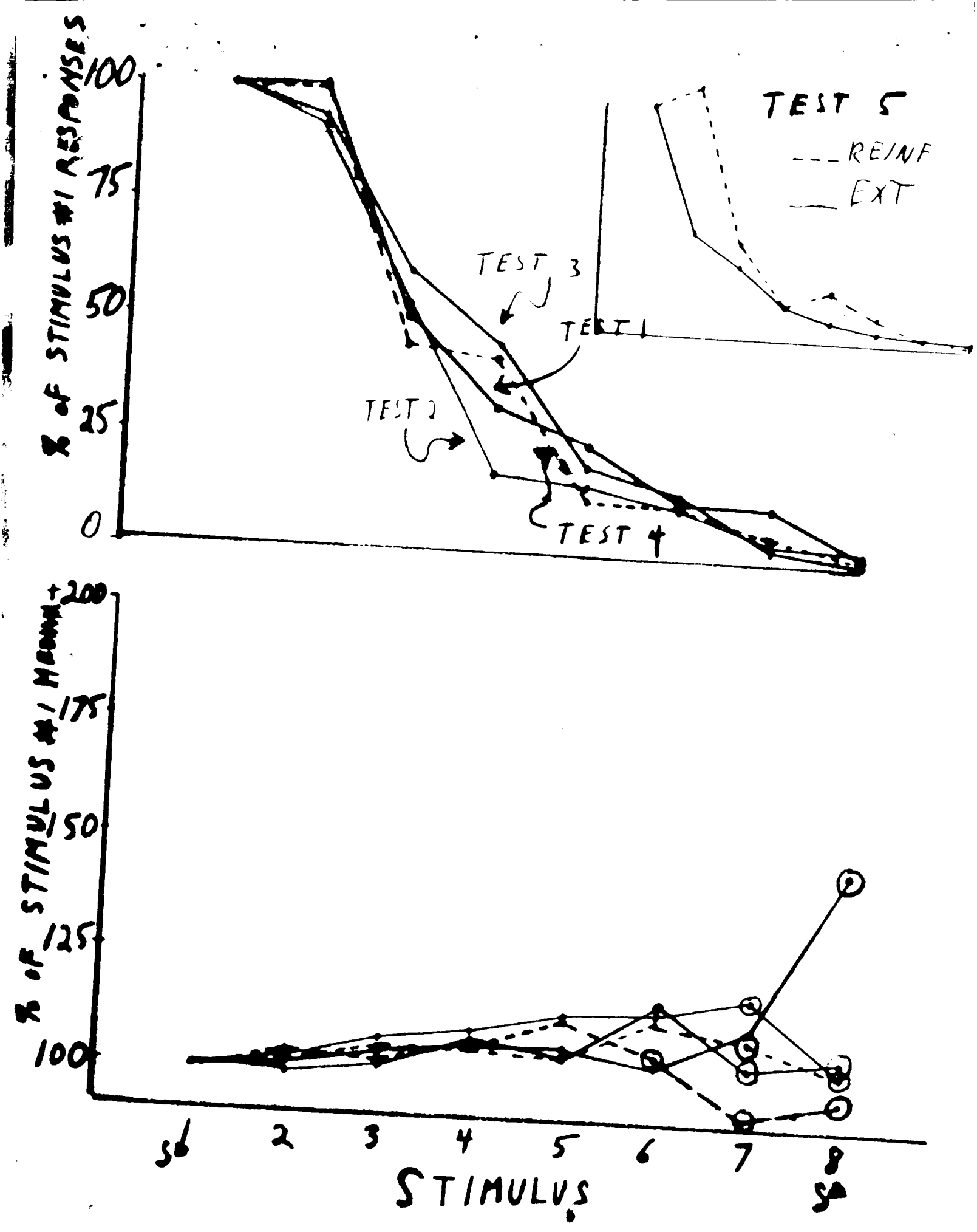
4. The random ratio was reduced to 5.

Discrimination training was carried out for 46 additional sessions before further generalization tests were made. Three generalization tests were made with each separated by one day of regular discrimination training. During the generalization tests responses during the original S^D stimulus were reinforced as usual (in combination with the reduction of the random ratio to 5, this prevented the rapid extinction seen under the earlier procedure) and the entire session was devoted to generalization testing. The eight stimuli were presented in a mixed sequence, with each stimulus presented 160 times per session.

The results of the three sessions of generalization testing for one of the animals is shown in Fig. 1. Several preliminary points should be noted about the figure. The abcissa represents the decreasing intensity values (which were actually in log steps) for stimuli 1 through 8. The actual values, in foot candles, were 16.30 (S^D), 10.87, 8.24, 4.83, 3.21, 2.14, 1.13, and .95 (S^Δ) respectively.

All the data is plotted relative to the performance in stimulus 1 (S^D). That is, for the upper part of the figure in which the rate gradient is plotted across stimuli, the number of responses in stimulus 1 is considered as 100% and the rest of the values are derived by comparison (for example, for stimulus 6 the point is derived by: responses in stimulus 6/responses in stimulus 1).

In the lower part of the figure the results for the three test sessions is plotted using the difference in median A-B times. In this case as with responses, all medians were compared against the median in stimulus 1.


% of STIMULUS #1 RESPONSES
100
75
50
25
0
TEST 5
---REINF
—EXT
TEST 3
TEST 1
TEST 2
TEST 4
% of STIMULUS #1 MEANS
200
175
150
125
100
S1
2
3
4
5
6
7
8
S2
STIMULUS

The points in the figure which were circled are probably unreliable since the number of values available for computation of the median ranged from 17 to 5. The upper figure indicates that the frequency at which the rat executed the A-B sequence declined regularly over the stimulus continuum. (Responses in stimulus 1 were reinforced with food and this may have depressed the rate somewhat in this stimulus.) The changes in median A-B times on the other hand are much less. For example, in stimulus 5 the rat showed at least a 75% change in the frequency of execution of the A-B sequence while the change in median A-B times were generally under 20%. It is to be noted, however, that there was a reliable slowing in the A-B times, although the magnitude of these changes (considering only the reliable data points) was not very large.

The data obtained from the second animal in this experiment showed essentially the same relationships as those described above.

Discussion:

The conclusion to be drawn from these results in brief, is that the behavior that occurs in the region of S^{Δ} during stimulus generalization testing and in S^{Δ} in discrimination training appears at approximately full strength, that is, it has the essential properties of the behavior seen in S^{D}. The generalization procedure principally affects the rate at which the "S^{D} behavior" occurs.

The principles of laboratory animal care as promulgated by the National Society for Medical Research were observed.